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vices they render to man in the economy of nature, and will, it is hoped, tend to show that it is the duty of all, especially of agriculturists, to preserve such valuable animals.—*Canadian Naturalist and Geologist.*

FRESH WATER SKETCHES. *

BY PROFESSOR L. W. BAILEY.

It must not be inferred, from the title above given, that it is the purpose of the author, in the following "Sketches" to impose upon the readers of the NATURALIST, either a temperance tract, or a treatise on hydropathy, a fisher's manual, or even a guide to the lakes. The disciples of Isaac Walton will find that like Buller, I have tabooed the whole subject of angling, "and all its endless botheration about baskets and rods, and reels and tackle—salmon-trout, sea-trout, perch, pike, etc.,"—nor must the tourist look here for descriptions of the picturesque, the beautiful, and the grand, as displayed in the scenery of our unrivalled rivers, lakes and cataracts. My object, on the contrary, is to allude but slightly, if at all, to the charms of our inland aquatic scenery, or even to such objects of natural history, as may meet the eye of every observer, but rather to present, in a familiar way, some account of the minute, but marvellous wonders, which may be found by the aid of the microscope in every pool, pond, lake or river in our country. As the sketches in question have not the formality of a scientific treatise, and are divested to a considerable degree of technical language, I hope they may find some readers among those who might be repelled by a more pretending title or a more ponderous theme. If they serve to recall to the accomplished microscopist, some of the pleasures which have often "lent a charmed loneliness" to my own pursuits, or if they shall succeed in awakening in any that curiosity and desire for more intimate knowledge, which can only be gratified by original research, I shall feel that I have not misapplied that labor to which I have been urged by

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*The idea of these sketches was first suggested by some manuscript notes, left among the papers of my father, the late Prof. J. W. Bailey, of West Point, and which had been written with a view to the preparation of a small volume, similar in its general character to "the Sea-side Book" of Harvey, but relating exclusively to the more minute and microscopic forms to be met with in ordinary fresh waters. A few pages only of this work having been completed, and the present writer not being in a position to carry out the intention originally entertained, he has, in the following pages, embodied a portion of the notes in question, in a modified form, with the results of such observations as he has himself been able to make upon the subjects alluded to.—L. W. B.

> "That fond desire which dwells in human breasts,
> When pleased, their pleasures to extend to those
> Of kindred tastes."

I. THE POND AND ITS FLOWERING PLANTS.

> "What loved little islands, twice seen in the lake
> Can the wild water-lily restore."—CAMPBELL.

Is there any New Englander, any Northerner, to whom these words do not recall some favorite haunt of his youth, some of those beautiful and bright sheets of liquid crystal, which are so profusely scattered over the northern portions of our country, lending beauty to many a landscape, which, without these ornaments, would be dull and uninteresting? All who remember such scenes, will agree that what the lakes are to the landscape, the lilies are to the lake, adding a charm which we never fail to miss when they are not present. Without them there is always felt a loneliness, a want of animation and cheerfulness, the cause of which we may not be conscious of, but the contrast to which is at once perceived if we chance to find a pond

> "Where in the midst, upon her throne of green
> Sits the large lily, as the water's queen." — CRABBE.

We then feel that she it is who apparently lends life and light to all around, and we can but acknowledge that she well deserves her aquatic throne.

In company with this queen of the waters, there is usually found a bright bevy of maids of honor well worthy to grace her court. The delicate little Floating Heart (*Limnanthemum lacunosum*), the curious Water-shield (*Brasenia peltata* Pursh) the purple and yellow *Utricularia* are among her train; while the coarse but curious Yellow Lily (*Nuphar advena* Ait), the slender Pipewort (*Eriscaulon septangulare*), the white Arrow-head (*Sagittaria variabilis*) and the purple Pickerel-weed (*Pontederia cordata* L.) stand as sentinels around. But, as I have said, it is not my intention to dwell upon those charms of lake scenery which must be obvious to every observer. Let us then turn not unlovingly from what he who runs may read, and armed with the microscope seek out new sources of pleasure in its wonderful revelations.

The plants to which reference has been made, though in themselves far from being microscopic, afford many points of interest to the microscopical botanist. In the Nymphæa, Nuphar and Limnanthemum, for example, are presented vessels of an unusual form, marked like the ordinary dotted ducts so common among land plants, but singularly branched in a manner quite unlike what is usually met with in the latter. These vessels may be easily seen in a thin slice of the stems of the leaf or flower, or they may be obtained completely isolated by letting portions of the plant macerate in a glass of water for a few days in summer, until partial decomposition has taken place, when the vessels in question may be easily picked out with the point of a needle and examined by themselves. In the pure limpid jelly which invests the younger parts of the Water-shield (*Brasenia peltata*) is another object which cannot fail to attract the attention of the botanical student. If this be examined under the microscope, it will be found that the plant is not surrounded, as it appears to the naked eye, by a mass of homogeneous unorganized jelly, but that it is covered with minute hairs, each one of which is the axis of a cylindrical mass of jelly excreted by itself. In the Pickerel-weed (*Pontederia cordata*) an interesting subject of study may be found in the slender crystals (*raphides*) contained within the large ellipsoidal cells, of which this plant contains such great numbers, both the crystals and the cells being much like those which have been called "Biforines" and which occur in Calla, Arum and other plants of the natural family *Araceæ*. The true *biforines* when separated from the other tissues in water, rapidly discharge the crystals from one or both ends of the cells, and often with such force as to drive the cells backwards like a rocket, but this action is apparently wanting in the crystalline bundles of Pontederia. The diaphragms or thin plates of cellular tissue, met with in the stem and petioles of this plant will also be found to afford very beautiful objects for the microscope.

The Water Lobelia (*L. Dortmanna*) is an interesting plant, easily recognized by its naked stem flowering above water, while its base is surrounded by a bunch of radical leaves reduced to mere petioles. This plant, like all of its tribe, has a milky juice, and the latex vessels in which it circulates may be found in the leaves, and be isolated with great ease by the method of maceration and partial decomposition above mentioned. A better plant for exhibiting this peculiar form of vegetable tissue can scarcely be found.

Among the most interesting of the aquatic plants are the Duck-weeds (species of *Lemna*) some of which are the smallest of all flowering plants, and yet possess every essential organ. The leaf and stem are confounded while the root is reduced to one or more capillary fibres, in the centre of which minute spiral vessels may be detected. On the surface of the pond, are *stomates* or breathing-pores of the usual form, and among its cells may be found starch globules and a few cylindrical and stellate groups of crystals. The flowers are the simplest possible, consisting of two staminate and one pistillate flower, supported by a scale-like spathe, and with no trace of any other floral envelope. The male flowers have but one stamen and one of these flowers always comes to maturity, and discharges its pollen in advance of the other. The pollen, when received upon the stigma, develops pollen-tubes as in other plants. In short, no structure or function of the larger plants is wanting in these dwarfs of Flora's kingdom. The Duck-weed is one of the plants which often form "the green mantle of the standing pool," which is often considered as the evidence of impurity, but which, like all growing vegetation in such situations, by absorbing nitrogenized matters and evolving oxygen serves to purify and sweeten the water. Any one may convince himself of this important agency of growing plants by putting a little decaying organic matter in two vessels of water, one of which has growing plants immersed in it, and the other has not. The last will be putrid and offensive in a few days, while the former may be kept for months in a pure condition. The Lemna may be easily kept in a glass of water with a little pond mud at the bottom, and may be thus watched in all its stages of development. It will be found that it has the singular habit of hibernating. On the approach of cold weather, it will be seen to sink to the bottom of the vessel where it will remain all winter, but will rise again to float on the surface as soon as it feels the warmth of the vernal sun.

Let us now quit the surface of our pond, and, looking below, see what we can find in its "green and glassy gulfs." True to our plan of only attending to the microscopic, I shall not stop to describe the various interesting submerged plants which will naturally attract the attention. The beautiful feathery *Myriophyllum* and *Naias*, the interesting *Ceratophyllum*, the submerged leaves of the white and yellow Ranunculus (*N. aquatilis* and *N. Purshii*) reduced to a mass of branching vessels, with a mere trace of parenchyma; the various species of Potamogeton, the Hippuris, etc., etc., will all prove of great interest to the botanical student, but we will at present attend to those plants only which afford good views of the motion of the sap.

Among the best plants for studying this circulation are those of the *Chara* family, a group of plants formerly included among the Algæ, but now regarded as occupying a separate and somewhat higher position. They are very common in ponds, streams and ditches in all parts of our country, and may easily be recognized by their leafless stems and branches composed of long joints which are scarcely larger around than a common knitting-needle. Each of these joints is a single cell, within the walls of which are seen minute green particles, arranged in parallel lines, which go obliquely around the joint, leaving at one place a narrow colorless band. It does not need a very high magnifying power to see in these tubes a most beautiful display of the phenomena of circulation. The fluid may be seen

> "in fluent dance
> and lively fermentation mounting"

along one side of the colorless band, and proceeding along the whole length of the joint until it reaches the extremity, where it turns down on the other side of the same band. The large starch globules and other masses which are borne along by the current, enable us to follow its course and even to measure its velocity.

A very full account of the observations made on the circulation in *Chara* and *Nitella*, by Amici, Slack, Varley, Dutrochet and others, will be found in Hassal's Fresh Water Algæ. p. 78. These plants may be kept in glass vases without any trouble and will prove of great interest to the microscopist not only for the phenomena of circulation but also for the curious structure of their organs of reproduction. These organs are known by the name of the nucule and the granule, the former being considered by some authors as the female and the latter as the male flower. The nucule consists of a globular body surrounded by fine spirally-twisted tubes which closely envelop it. It contains numerous starch globules and is capable of germination. These nucules when ripe are quite hard and not being readily decomposed are often met with in a fossil state in fresh-water deposits. Lamarck mistook them for the shell of a mollusc and called them *Gyrogonites*. The granule differs much from the nucule. Its exterior presents a number of triangular plates with radiating cells and indented edges. Each one of these plates supports in its interior a cluster of fine articulated threads, in each joint of which is coiled up a spiral cileated filament. Upon the bursting of the globule, these filaments (*spermatozoids*) escape into the water, where their wonderfully active movements have led to their being looked upon as true animalcules. They are, however, merely agents in the fertilization of the germ-cell, and are analogous to the singular bodies discovered by Meyen in the antheridia of mosses.

The Nitella (Chara) presents such curious phenomena that it is certainly worth the trouble of keeping it, and nothing is easier than to effect this. Each cell of the plant seems to have its own independent life, so that if any portion of the plant be thrown into a glass of water with a little pond mud, it will continue to grow and flourish. "I have sometimes known it in winter to separate at its joints, so as to give a number of completely isolated cells, each one of which continued alive all winter, displaying the ordinary circulation, and in the spring developing a whorl of new joints."*

Another plant also easy of cultivation is the Water-tape (*Vallisneria spiralis* L.) which shows the circulation not less beautifully than does the Nitella. This plant grows in immense quantities on the flats in the Hudson River, and sometimes to such an extent as to afford a serious obstacle to the passage of a boat. Its singular mode of fecundation is thus described by Dr. Gray in his excellent "Botany of the Northern States."† The staminate flowers being confined to the bottom of the water, by the shortness of the scape, the flower-buds themselves spontaneously break away from their short pedicels and float on the surface, where they expand and shed their pollen around the fertile flowers which are raised to the surface at this time; fertilization being thus accomplished, the thread-form fertile scapes coil spirally, and draw the ovary under the water to ripen." It is to these phenomena that the fanciful Darwin alludes in the following lines—

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*J. W. Bailey. †p. 463.

> "As dash the waves on India's breezy strand
> Her flushed cheek pressed upon her lily hand
> Vallisner sits, upturns her tearful eyes
> Calls her lost lover and upbraids the skies."
> —Loves of the Plants.

In future "sketches" we shall endeavor to obtain some further glimpses at the marvels of *pond-life.*

Note.—The circulation of the fluids may be seen in many land as well as water plants. The currents in the moniliform hairs on the anthers of the common Spiderwort (*Tradescantia Virginica*) are well known to microscopists, and, indeed, it has been ascertained that the hairs of most plants in some stage of their growth exhibit similar phenomena. Among our native land plants few exhibit a finer display of these phenomena than may be seen in the young hairs on the fruit of the Enchanter's Nightshade (*Circæa Lutetiana* L.). Currents bearing along large albuminous? masses and much resembling those in Chara will be found in all the young hairs around the base of the flower and fruit of this plant. Currents more like those of *Tradescantia* may be seen in the hairs within the corolla of the common Foxglove of the gardens. Lindley states that the large cells of the rhizoma of the Scouring Rush (*Equisetum*) show very distinct currents, and the writer has seen beautiful displays of these phenomena in the cells of the root of the common Asparagus.

MODE OF PRESERVATION OF VEGETABLE REMAINS IN OUR AMERICAN COAL MEASURES.*

BY LEO LESQUEREUX.

Remains of Plants in Coal.—It has been erroneously asserted that the coal itself does not contain any recognizable vegetable remains, it being merely a mass of bitumen, independent of any of the plants which are found in the shales overlaying or underlaying it. Our bituminous coal is generally a compound of supposed layers of crystalline matter, about one-eighth of an inch in thickness, separated by a thin coat of pulverulent coal, or mineral charcoal, which is a mere compound of cellular tissue and of vessels of plants.†

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*From the Fourth volume of the Geological Survey of Illinois. A. H. Worthen, Director. 1870.

†This fact is easily ascertained by microscopical examination. Prof. J. W. Dawson, of Montreal, has closely examined this charcoal, and published, as results of his interesting researches, numerous forms of vessels of plants. The same kind of researches had been already pursued by Prof. Goppert, who had recognized, in this pulverulent coal, remains of plants of every family hitherto known to occur fossil in the coal. (Quar. Geol. Jour., vol. 5, mem., p. 17.)